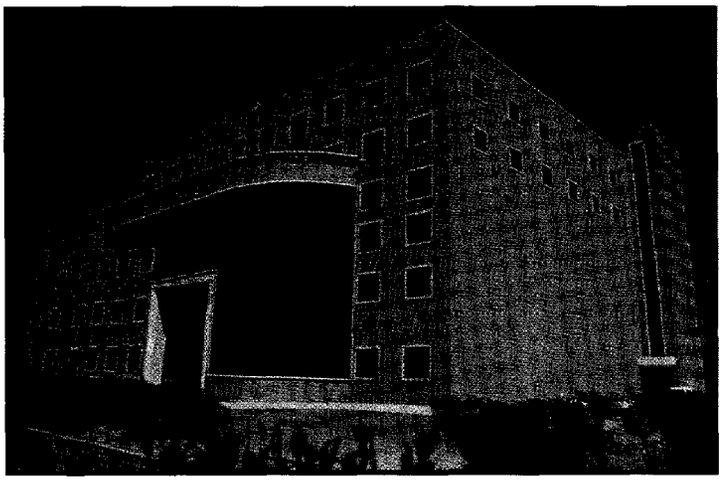
Korean 6" GaAs foundry opened

In June Knowledge*on Inc (Iksan, South Korea) started operating its 6" InGaP HBT and MMIC foundry, which will develop products for wireless (CDMA, GSM, DCS and 3G) and optical (40 Gb/s) communications applications. Commercial production should start by end-2001. The 35,000ft² facility is expected to produce more than 3,000 wafers per month.

Knowledge*on Inc
Tel: +82-63-8391111



Conexant cutting 450 jobs; shifting from Si to SiGe & GaAs

For Conexant Systems Inc (Newport Beach, CA, IJSA) sales were U-8200.1 m for the June quarter (down 20% on the March quarter, and lower than April's forecast of US$206m). This **comprised:**

. US$164m for the "personal networking" business (down 3%);

. US$36m for the Mindspeed Technologies Internet infrastructure business (down 56%, rather than the forecast 35-45%).

"*We remain committed to completing the separation of Conexant into two independent, publicly traded companies as soon as business and market conditions are clearly on a recovery path*," said chairman and CEO Dwight W Decker.

However, Conexant is to accelerate its transformation to a fabless company by shifting away from digital CMOS silicon manufacturing and discontinuing technology development beyond its current 0.13µm process. Conexant expects to announce a broadened, long-term foundry supply agreement covering most of its future CMOS wafer requirements.

However, it will continue to invest in "specialty-process manufacturing". It will downsize its Newport Beach fab (focusing increasingly on SiGe) and continue to invest in its Newbury Park GaAsfab.

"*This strategic realignment will allow us to avoid the ever-increasing R&D investments and capital requirements of mainstream digital CMOS process development and manufacturing*," said Decker. "*Instead, we can increase the allocution of our resources toward the design and marketing of innovative communications semiconductor products.*"

To save a further US$175m annually it will cut 450 jobs (6% of its workforce - 420 full-time staff and 30 contractors). With the 1,500 redundancies announced in March, this **totals** 25% (saving US$375m).

In July Conexant said it was also temporarily shutting down its fabs and reducing work-weeks for staff at its assembly and testing facilities.

Microsemi ships first flip-chip InGaP HBT power amplfiers for W-CDMA

Microserni Corp (Irvine. CA, USA) is shipping its initial InGaP/GaAs HBT power amplifiers for W-CDMA handsets (which are to be produced in volume in January 2002).
This is aligned with the roll out of W-CDMA service (with initial service starting as early as October in Japan).
The industry's first flip-chip InGaP HBT PA for W-CDMA is offered in bare die, external I/O matched 3x3mm² chip-scale package and 6x6 mm² matched module. Flip-chip packaging will allow further advantages in its next-generation module design (with lower RF parasitics and smaller size eliminating wire bond pads).

Technology: Microelectronics

GaAs Cable TV amplifiers

ANADIGICS Inc (Warren, NJ, USA) is sampling the single-supply +5V ARA2005 GaAs CATV reverse amplifier, which provides the reverse path amplification and output level control functions for two-way CATV systems. It was developed for high-speed cable modems, telephony over cable systems and open cable set-top boxes and meets requirements of fibre nodes, mini nodes and CMTS (Cable Modem Termination Systems).

Motorola (Phoenix, AZ, USA) has introduced the 870 MHz MHW9187 GaAs-based CATV amplifier (for 79-, 112- and 132-channel performance) for maximum output capability to improve system distortion and drive longer lines. This is the first in a series of products designed with its HVPHEMT 2 (High Voltage pHEMT) process, which reduces the number of cascaded amplifiers needed.

Additional products in development include higher-gain output amplifiers and a complete series of pre-amps.

* Motorola Inc's Broadband Communications Sector (Motorola Broadband, Horsham, PA, USA - created when General Instrument Corp was acquired in January 2000) is to supply Beijing Gehua CATV Network Co Ltd with its STARLINE RF amplifier, OmniStar optical head-end, and SG optical nodes for its two-way network upgrade project.

Its latest Broadband Line Extender, Mini-Bridger Amplifier, and Broadband Telecommunications Amplifier include Motorola BCS's Exclusive Enhanced GaAs (E-GaAs) hybrid technology for maximum output level and improved distortion performance.

Technology: Microelectronics

Brief News - GaAs

Celeritek Inc (Santa Clara, CA, USA) has supplemented its WideFiber family with the CMM2030-BD medium-power 23 dBm GaAs pHEMT pre-driver amplifier (operating up to 32 GHz). It is targeting external lithium niobate fibre-optic modulators in high-bandwidth applications that require a high extinction ratio.

By providing more gain, power consumption can be reduced as much as 75%. Output voltage of 7.5 V peak-to-peak can be achieved when used with the CMM3020-BD amplifier.

United Monolithic Semiconductors (Orsay, France) has launched the WAOI-PO 8971, a fully integrated DC-40 GHz transimpedance amplifier for OC-768 application as optical interface. It uses UMS' PH15 process and has transimpedance gain of 25dB and gain flatness of ±1dB.

Hittite Microwave Corp (Chelmsford, MA, USA) has opened its first international office, **Hittite Microwave Europe Ltd**, in the UK (Tel: +44 1-256-817-000), to house Sales and Field Applications Engineers.

Also, Hittite has appointed the following official representatives:

- **Custom & Wireless Sales** (Campbell, CA, USA; Tel: +1-408-371-0222) for Northern California and Nevada; and
- **N&W Sales Inc** (Arlington, TX, USA; Tel: +1-817-461-4443) for Texas, Oklahoma, Arkansas, and Louisiana.

GaAs RF IC manufacturer **Filtronic Compound Semiconductors Ltd** (Newton Aycliffe, UK) has received ISO 9002 accreditation for its management quality system (following January's ISO14001 award for environmental management systems).

Alpha allies with SAW filter maker EPCOS for switch/filter modules

As part of a roadmap based on its Alpha Integration Platform (aiIP), Alpha **Industries Inc** (Woburn, MA, USA) has formed a strategic alliance with Surface Acoustic Wave filter supplier **EPCOS AG** (Munich, Germany). They will co-develop, manufacture and market a new family of switch/filter modules (including control logic circuitry, switching and transmit/receive filtering), initially for dual-band (to be shipped in September) and eventually tri-band GSM handsets.

EPCOS is Europe's largest manufacturer of passive components, with expertise in Low Tempera ture Co-fired Ceramics (LTCC), which has become a major integration medium for passive and active RF components.

*Alpha has expanded its integrated module business in Asia by opening a Hong Kong office (under Bruce Usinowicz, Director of Asia Pacific Sales). It will provide design, applications and logistics support to new and existing customers.

"This sales expansion puts us closer to existing and prospective contract manufacturing and ODM customers," Usinowicz said. ***"For example, Taiwan, which had virtually no handsetproduction as recently as 1998, is expected to accountfor about 10% of the total production in 2001."***

MCM-packaged 5.8 GHz PA

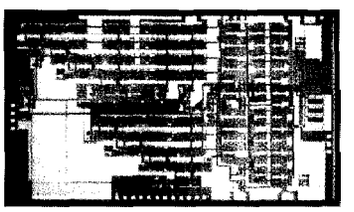
Highly integrated RFIC multi-chip module specialist RF Solutions **Inc** (Atlanta, GA, USA) is sampling the 5.8 GHz RFS1003 GaAs MESFET power amplifier (for production in Q4/2001) aimed at transmit applications in the 5.1-5.9 GHz band for broadband wireless access. It features a P1dB of 29 dBm, making it suitable for the final stage in fixed wireless applications requiring high transmit linearity.

Future additions for the 5.8 GHz (U-NH) band will include a downconverter, an upconverter and a low-noise amplifier/switch.

Fastest digital frequency synthesizer

Under contract to the US Navy's Office of Naval Research, TRW Space & Electronics' **Velocium** (Redondo Beach, CA, USA) has developed a "frequency synthesizer on a chip" (with over 3,000 InP HBTs) which operates at 7 GHz (more than three times faster than any previous direct digital frequency synthesizer).

"High-speed direct digital frequency synthesis will enable us to develop the Navy's next-generation electromagnetic systems employing Advanced Multifunction Radio Frequency Concepts [expected to provide the basis to combine communications, radar and electronic warfare functions into a single, integrated aperture] ," said Max Yoder, director of the Electronics Division at the ONR.



Pictured **Circuit** *for Velocium's 7 GHz "frequency synthesizer on a chip" (which features over 3,000 InP HBTs).*

"Direct digital frequency synthesizers provide far greater control over the frequency and phase of the signal than do conventional analog synthesizers," Yoder said. The added control is valuable for the highly accurate rapid frequency and phase changes required by future military electronic systems. Direct digital synthesis also lowers phase noise, heightening system sensitivity.

"Velocium's development of InP for commercial markets gives us the volume production we need to reduce the cost.. .and positioning us to bring high-speed digital frequency synthesizers to telecommunications system developers," adds Yoder.

GTRAN ships first 40 Gb/s SONET products

GTRAN **Inc** (Westlake Village, CA, USA) has shipped the world's first 40Gb/s products for SONET applications (made using its recently released 200 GHz InP-based process):

- TIAs have a *300* W transimpedance and 45 GHz bandwidth. Operating with dual positive and negative 3.3V supplies, it dissipates 150 mW;
- Single-supply -4.2V limiting amplifiers (in a leaded ceramic package) have 40 GHz bandwidth, differential gain greater than 30dB with an input sensitivity of 10 mV, and power dissipation of 500 mW.

"Our commercial InP process and advanced circuit design techniques allows us to reduce power consumption of our devices by a factor of three over conventional silicon processes," reckons GTRAN's president and CEO Dr Frank Lee.

More OC-768 SiGe ICs; plus InP from Vitesse and Velocium/Hitachi

Several chip makers are now developing GaAs, InP, SiGe, and even standard CMOS physical-layer (PHY) devices for 40 Gb/s OC-768 networks (which carriers aren't expected to deploy until 2003 or later).

At June's *Supercomm* 2001 trade show in Atlanta, GA, IJSA, Infineon Technologies (Munich, Germany) launched samples of "the world's first multiplexer/demultiplexer chip-set for OC-768 (40 Gb/s SONET/SDH) applications". This comprises single-supply 5.5V FOA4400 mux and FOA5400 demux chips (with 16 2.5 Gb/s input channels) based on its SiGe technology:

- the multiplexer has a Clock Management Unit and a selectable 20 and 40 GHz clock output to support both No-Return-to-Zero and Return-to-Zero line coding, respectively;
- the demultiplexer integrates Clock and Data Recovery with extremely high input sensitivity of 50 mV. Supported data-rates range from 39.8-43 Gb/s, enabling out-of-band Forward Error Correction.

Along with OC-768 SONET/SDH framing/mapping, pointer processing and STS- 1 granularity technology - which was acquired at end-April along with fabless company Catamaran Communications Inc (San Jose, CA, IJSA) for US$250m in stock - the chip-set is a key component of the industry's first complete line card solution for 40Gb/s communication systems (from the optics to the network processor interface).

Agere Systems Inc and Conexant Systems Inc are also developing SiGe-based OC-768 devices.

Applied Micro Circuits Corp (San Diego, CA, USA) also plans to launch OC-768 devices built with IBM's SiGe process (on a foundry basis).

At May' ***Indium Phosphide and Related Materials*** conference in Nara, Japan, IBM's Microelecronics Division said it had started making customer circuits with its next-generation 7HP 0.18 μm SiGe BiCMOS process (which has an SiGe HBT with f_T = 120 GHz) for 40 Gb/s (OC-768).

IBM has also announced 210 GHz SiGe HBTs which draws only 1 mA of current (see the feature article on page 36). This, it says, is better than the current InP HBTs coming onto the market.

Also at ***Supercomm 2001,*** Hitachi Ltd's optical-component spin-off OpNext Inc (formed last Autumn) and Velocium (formed in May as part of TRW Space & Electronics, Redondo Beach, CA, USA) announced a non-exclusive agreement to co-develop InP GaAs networking chips for use with OpNext's own internally developed components in its 40 Gb/s (OC-768) fibre-optic transceivers (for delivery later this

In May Hitachi and Velocium also announced plans to jointly develop new power amplifier modules for 3G cell-phone handsets.

Corp

ship its first OC-768 parts in early 2002 using InPHBTs (see overleaf).

Broadcom Corp, however, believes that standard CMOS can

OC-768

tasks as well as most 10 Gb/s

GCS launches its first 4" InP epiwafers

Global Communication Semiconductors **Inc** (Torrance, CA, USA) has launched its first 4" InP wafer and has already secured orders from seven companies making OC-768 products and three companies developing 3G applications.

About 250 wafers are coming off the line each week. InP yield is already up to 80%.

GCS claims a total capacity of 2,000 wafers per month. It also plans to open a new fab in the USA with an initial capacity of 5,000 wafers per month (mainly 4": 80% for InP and InGaP HBTs; 20% for pHEMT and SAW filters), starting volume production in Q1/2002.

GCS is aiming for nearly US$ I Om in revenues this year and US$30m for 2002 (hoping to break even by August 2002).

Vitesse samples its first-generation indium phosphide ICs for 40 Gb/s

Several months ahead of schedule, Vitesse Semiconductor **Corp** (Camarillo, CA, USA) has sampled and characterized the first working demonstration products in its first-generation InP process technology. These are for analog and digital HBTs in physical layer ICs for SONET OC-768 40 Gb/s data rates and 10 Gb/s systems that use Return-to-Zero data encoding.

Vitesse has been using foundry, However, since January 2001 it has been converting about 50% of its own 4" GaAs line to InP. First HBTs were completed in December 2000. It is also contemplating offering foundry access for strategic partners.

Vitesse's InP process uses a vertical, mesa-isolated npn bipolar transistor with a peak f_T of 150 GHz and f_{max} of 160 GHz. This is consistent with the bandwidth and edge rate requirements of circuits operating at 40-50 Gb/s (enabling the use of forward error correction) and capable of data rates well beyond 50 Gb/s.

Succeeding generations of InP will be geared for up to 100 Gb/s data rates and integrated optical devices. This will enable true monolithic optical integrated circuits (OEICs).

The Director of the InP Program Alan Huelsman PhD says "*InP is the only IC technology that combines the high frequency performance und high breakdown voltage required to implement all transmit, receive and clock recovery functions far 40 Gb/s systems. All other IC technology choices result in compromises in system performance or complications in architecture for thermal or functional partitioning considerations.*" Also, he adds, "*InP is the only IC technology that provides a path to monolithic integration of long wavelength optical sources and detectors.*"

***Analysts** forecast that the total 40 Gb/s port count will total 30,000-50,000 **by** 2003 (a US$120-200m market for physical-layer devices).

* Vitesse is acquiring - for about US$250-260m in stock Versatile Optical Networks **Inc** (San Jose, CA, USA), a 72-person, l-year-old company which designs and makes optical and optoelectronic modules.

Versatile has developed a multilevel, building-block architecture for integrating optical and OEO (optical-to-electrical-to-optical) solutions. initial products include optical switches. transponders and transponder **arrays.** Vitesse's president and CEO, Lou Tomasetta says it can now provide "a complete solution of communication components from the fibre to the backplane."

Mitel becomes Zarlink for comms ICs; using IBM foundry for first SiGe chips

After shedding its operations in enterprise communications systems at the end of May, **Mitel Corp** (Ottawa, Canada) has changed its name to **Zarlink** Semiconductor (with new president and CEO Patrick J Brockett) to emphasize its new focus on communications ICs for wired, wireless and optical connectivity in voice and data networking (as well as ultra-low-power chip-sets for medical applications).

Zarlink is using IBM's foundry for its first SiGe-based chips - high-performance, low-power RF tuners for digital TVs, set-top boxes and cable modems, plus cell-phone chips for multi-frequency handsets and base-stations (currently sampling).

IBM and Zarlink are also working together on SiGe process enhancements to meet Zarlink's requirements for highly specialized and integrated RF and digital functions. Zarlink will begin using SiGe for other products (including high-speed networking chips) later this year.

* After a joint program to develop short-reach optical solutions operating at 2.5 Gb/s per channel, Applied Micro Circuits **Corp** (San Diego, CA, USA) and **Zarlink** are co-developing multi-channel, inter-operable 10 Gb/s per channel products for complete short-reach optical connectivity in high-capacity, next-generation networking systems.

Zarlink will launch 1 Z-channel, 10 Gb/s per channel VCSEL-based parallel fibre modules. AMCC will launch inter-operable physical layer, switch fabric, network processing and framer products Together these will enable a complete 40 Gb/s transponder solution for Very Short Reach OC-768, compliant with proposed Optical Internetworking Forum standards.

*At June's *SuperComm 2001* in Atlanta, GA, USA, AMCC demonstrated a complete VSR OC-192 Coarse Wavelength Division Multiplexing link using single-fibre VCSEL-based modules.

Intersil's SiGe 5 GHz WLAN chips

Intersil Corp (Irvine, CA, USA) has entered a new wireless local-area network chip market with its Prism Indigo chip-set (scheduled for sampling in Q4/2001).

The Prism Indigo is targeted at not just the 2.4 GHz 802.1 la WLAN standard but also the emerging 5 GHz broadband 802.1 lb standard. The power amp and RF/IF portions are based on IBM's SiGe process.

* According to **Cahners** In-Stat, the total WLAN chip-set market is expected to exceed US$1.2bn **by** 2005.

New SiGe entrants

Alcatel SA is still one of several SiGe foundry "customers" of IBM, but now Motorola Microelectronics (Brussels, Belgium) has launched its own 0.35 μm SiGe BiCMOS process (co-developed with IMEC in Leuven, Belgium). The 50 GHz f_T and 80 GHz f_{max} process includes high-tuning-range vat-actors, thick-metal inductors with Q-factors above 10, and dense metal capacitors of 1.5 fF/μm².

R&D Director Marnix Tack says it is twice as fast as silicon BiCMOS, enabling development of wireless chips operating at frequencies up to 10 GHz, but significantly lower power consumption. Its first device is a low-noise amp for the mainly European Hiperlan2 wireless LAN standard (competing with the Prism WLAN chip-set of IBM's largest SiGe foundry customer Intersil. It will also develop devices for digital-cellular wireless applications.

In a "dual-fab" approach, it will make "speciality" high-end BiCMOS- and SiGe-based chips in its own 140,000 wafer per year 4" and 90,000 wafer per year 6" fabs, while most of its silicon ADSL chip-sets are made in Asian foundries. However, it doesn't rule out using a pure-play SiGe foundry in the future. But "***Right now, it's extremely difficult to transfer your [SiGe]*** process ***technology and product lines to another fab***," says vp of technology Paul DeFraeye.

STMicroelectronics (Geneva, Switzerland) says it can build faster, lower-noise RFICs more cheaply than those with dedicated SiGe processes by adding SiGe to its established 0.35 μm silicon BiCMOS process (which is already in volume production in multiple fabs). It is optimized for lower-cost, high-performance RFICs using a non-selective epitaxy SiGe module (with f_T = 45 GHz).

"At close to 2 GHz, it is very challenging to build dual-band LNAs in BiCMOS. SiGe can deliver a two-times improvement in power consumption and improved noise figures," says RF business development manager Jean-Pierre Aubert.

But for finer-geometry processes it will use selective SiGe epitaxy. An enhanced 0.25 μm version with f_T = 70 GHz is already in prototyping and should be in production in 2002. "***We don't see a performance difference between selective and non-selective, but we are looking at selective for new developments,"*** said Aubert. ST will use the new process for RFICs for a range of hand-held terminals, home wireless networks and Bluetooth radio-connected peripherals. ST also has carbon-doped SiGe at the R&D stage.

TSMC (Hsinchu,Taiwan) is also starting with blanket SiGe epi then moving to a selective version for 0.18 μm technology (to come on-stream in September 2002).

As it targets analog and RF chips, TSMC is lining up a portfolio of design kits and intellectual property libraries from IP suppliers for its CMOS analog process.

Cypress Semiconductor Corp is in the final stages of developing a SiGe process at its HQ in San Jose, CA, USA (based on its 0.25 μm silicon BiCMOS), for production in Q4/2001 at its fab in Minneapolis, MN, USA (initially for physical layer components for 2.5 Gb/s OC-48 networks, and subsequently for faster systems).

By end-200 1, capacity should be up to 100 8" SiGe wafers per week (all captive, with no plans to offer foundry), says senior director of technology Shahin Sharifzadeh.

At June's *Supercomm* in Atlanta, GA, USA, On Semiconductor Corp (Phoenix,AZ, USA) said it was sampling its first SiGe products (for volume production in Q3).

Supporting broadband applications up to 12 Gb/s, the first member of its GigaComm series -the 2.375-3.3V NBSG16- is a differential receiver/driver chip capable of supporting 10Gb/s OC-192 SONET speeds.